UNIVERSITI TEKNOLOGI MARA

TRANSPORT OF BED LOAD SEDIMENT IN THE PRESENCE OF STABLE CLAST

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Thesis submitted in fulfillment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Civil Engineering

April 2016

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Surface bedform in the form of stable clast is deduced to be presence at micro-scale. Stable clast is believed to modify the flow field and provide sink and source for incoming sediment particles. The dynamics of flow pattern and bed load rate in the presence of stable clast are always puzzling due to wide range of particle size and presence of roughness elements. Thus, this issue can be treated using two methodological approaches namely local scale and reach scale solutions. Incorporating the flow fields and turbulence statistics at a very local scale leads to the prediction of occurrence of bed load transport using probability approach. The binary model of dimensionless velocities for ejection and local bed shear using TKEw' gave better prediction among other models. Almost 80% of the bed load mechanism (whether occur or not) can be predicted by this proposed model. Understanding transport occurrence at finer scale is vital for in-stream rehabilitation, river restoration and installation of sediment sampler on river beds. However, treating the dynamics of flow and bed load at reach scale is significantly differed from local scale approach. Transport of sediment in the presence of stable clast at reach scale is best equipped using continuous transport prediction or reach-averaged bed load model. Transport of bed load sediment using existing prediction model postulate the less suitability and a need for modification. Thus, a similarity approach is used to develop the bed load model which can predict the bed load transport at reach scale. This new equation is successfully predicting the transport of bed load sediment in the presence of stable clast. Almost 70% of the selected river data portrayed better prediction compared to existing model. This newly proposed model make the full use of particle densimetric Froude number as the main predictor variable.

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CHAPTER ONE
INTRODUCTION

1.1 RESEARCH MOTIVATION

The natural progressions of erosion, transportation and sedimentation tend to be a dynamic process throughout geological time and have shaped the present landscape of our world (Julien, 2010). These processes take into account the linkages between flow patterns, geomorphologic landscape and human factors. The action of moving flow and transported sediment will form the channel that widely known alluvial channel. Discreet insight reveals that under various hydrologic and climatologic regime, the flow pattern and sediment flux respond differently (Vanoni, 2006). The presence of diverge morphological landscape further accelerate the dynamic of flow and sediment pattern. Hence, it is a dire need to study the linkages between diverge morphological landscape and its effect on flow and sediment pattern.

The complexities of surface organizations due to sediment and flow interactions are highly regarded as a component of nonlinear system at gravel bed rivers (Strom et al., 2004). Grain-scale organization includes such features as clast dams and ribs (Koster, 1978), stone cells (Church et al., 1998; Hassan and Church, 2000), patchiness (Nelson et al., 2009) and clustering (Strom and Papanicolaou, 2008; 2009). The presence of those structures brought a new dimension at looking the interaction between fluvial mechanics and river bedform. The bedform and surface structure are believed to be produced by the interactions among the flow fields and sediment transport processes (Strom & Papanicolaou, 2008). The uniqueness of those organizations and difficulty in developing the relationships that accurately account for them have added to the site specificity of resistance and bedload formulae (Strom & Papanicolaou, 2008). The wide grain-size distribution at gravel and mixed sand-gravel bed includes patches of finer; more mobile sediment and large; relatively immobile cobbles or boulders that are often arranged into specific configurations (Yager et.al., 2007). The stable clasts are represented by those immobile cobbles and boulders protruding from the river bed either in isolated forms or embedded forms. The stable clasts are observed to disrupt the flow (Wiberg and Smith, 1991; Byrd and Furbish,